Claims

1. A method for planarizing a patterned semiconductor substrate comprising:

receiving a patterned semiconductor substrate, having a conductive interconnect material filling a plurality of features in the pattern, the conductive interconnect material having an overburden portion;

removing a bulk of the overburden portion, a remaining portion of the overburden portion having a non-uniformity;

mapping the non-uniformity;

developing a dynamic liquid meniscus etch process recipe to correct the non-uniformity; and

applying a dynamic liquid meniscus etch process using the dynamic liquid meniscus etch process recipe to correct the non-uniformity of the remaining portion of the overburden portion.

2. The method of claim 1, wherein removing the bulk of the overburden portion includes removing the bulk of the overburden portion in a CMP operation.

3. The method of claim 1, wherein removing the bulk of the overburden portion includes removing the bulk of the overburden portion in a low down force CMP operation.

4. The method of claim 1, wherein removing the bulk of the overburden portion includes imparting a minimum lateral stress to the substrate.

5. The method of claim 1, further comprising, forming an additional layer on the overburden portion, the additional layer being substantially planar.

6. The method of claim 5, wherein removing the bulk of the overburden portion includes substantially entirely removing the additional layer.

7. The method of claim 5, wherein additional layer and the overburden portion have a substantially 1:1 etch selectivity.

8. The method of claim 1, wherein applying the dynamic liquid meniscus etch process using the dynamic liquid meniscus etch process recipe includes:

monitoring the dynamic liquid meniscus etch process; and

providing feedback to a dynamic liquid meniscus etch process controller.

9. The method of claim 8, wherein the dynamic liquid meniscus etch process controller automatically modifies at least one aspect of the dynamic liquid meniscus etch process recipe according to the feedback.

10. The method of claim 8, wherein the dynamic liquid meniscus etch process controller moves the dynamic liquid meniscus relative to a surface of the substrate.

11. The method of claim 8, wherein monitoring the dynamic liquid meniscus etch process includes scanning a surface of the substrate with a metrology sensor.

12. The method of claim 11, wherein the metrology sensor is included within the dynamic liquid meniscus.

13. The method of claim 11, wherein the metrology sensor maps the non-uniformity.

14. The method of claim 1, wherein mapping the non-uniformity includes determining a non-uniformity profile for the substrate.

15. The method of claim 14, wherein determining a non-uniformity profile for the substrate includes determining a non-uniformity profile model of the bulk removal process.

16. The method of claim 15, further comprising optimizing a bulk removal process used to remove the bulk of the overburden portion to substantially eliminate a production of a non-uniformity described by the non-uniformity profile model during the bulk removal process for a subsequently received patterned semiconductor substrate.

17. The method of claim 1, wherein developing a dynamic liquid meniscus etch process recipe to correct the non-uniformity includes:

determining a removal rate profile model for a subsequent process;

comparing the non-uniformity profile for the substrate to the removal rate profile model for the subsequent process; and

optimizing one or more parameters of the subsequent process.

18. The method of claim 17, wherein the subsequent process can include at least one of a group of processes consisting of the dynamic liquid meniscus etch process, a dry etch process, and a wet etch process.

19. The method of claim 1, wherein the conductive interconnect material includes copper.

20. The method of claim 1, wherein the conductive interconnect material includes elemental copper.

21. The method of claim 1, wherein the pattern is formed on the patterned semiconductor substrate in a dual damascene process.

22. A semiconductor device formed by a method comprising:

receiving a patterned semiconductor substrate, having a conductive interconnect material filling a plurality of features in the pattern, the conductive interconnect material having an overburden portion;

removing a bulk of the overburden portion, a remaining portion of the overburden portion having a non-uniformity;

mapping the non-uniformity;

developing a dynamic liquid meniscus etch process recipe to correct the non-uniformity; and

applying a dynamic liquid meniscus etch process using the dynamic liquid meniscus etch process recipe to correct the non-uniformity of the remaining portion of the overburden portion.

23. A method of forming a dual damascene interconnect structure comprising:

receiving a dual damascene patterned semiconductor substrate, having a conductive interconnect material filling a plurality of features in the dual damascene pattern, the conductive interconnect material having an overburden portion having a non-uniformity;

forming an additional layer on the overburden portion, the additional layer being formed substantially planar; and

etching the additional layer and at least part of the overburden portion to remove a bulk of the overburden portion, the additional layer being substantially entirely removed, a remaining portion of the overburden portion having a non-uniformity;

mapping the non-uniformity;

developing a dynamic liquid meniscus etch process recipe to correct the non-uniformity; and

applying a dynamic liquid meniscus etch process using the dynamic liquid meniscus etch process recipe to correct the non-uniformity to of the remaining portion of the overburden portion.

24. The method of claim 23, wherein applying the dynamic liquid meniscus etch process using the dynamic liquid meniscus etch process recipe includes:

monitoring the dynamic liquid meniscus etch process; and

providing feedback to a dynamic liquid meniscus etch process controller.

25. The method of claim 24, wherein monitoring the dynamic liquid meniscus etch process includes scanning a surface of the substrate with a metrology sensor, the metrology sensor being included within the dynamic liquid meniscus.